

Los Alamos Large Scale Demonstration and Deployment Project
FY99 Demonstration Results and Status*

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ABSTRACT

This paper will discuss the results of technology demonstrations carried out by the Los Alamos Large Scale Demonstration and Deployment Project (LSDDP) in support of characterization and size reduction of large metal objects, a technical problem being addressed by several US Department of Energy (DOE) sites.

The Deactivation and Decommissioning Focus Area (DDFA) of the DOE National Energy Technology Laboratory is developing answers to the technological problems that impede DOE's extensive cleanup efforts. The optimized application of technologies to ongoing nuclear facility decontamination and dismantlement is critical in meeting the challenge of decommissioning approximately 9,000 buildings and structures within the DOE complex. At Los Alamos National Laboratory (LANL), a Large Scale Demonstration and Deployment Project was established by DDFA to facilitate demonstration and deployment of technologies for the characterization, decontamination, and volume reduction of oversized metallic waste, mostly in the form of gloveboxes contaminated with transuranic radionuclides.

Several demonstrations were conducted to evaluate technologies that improve the cost and risk associated with characterization and initial size reduction of crated large metal objects, with a focus on gloveboxes. Commercial air pallets were demonstrated for movement and positioning of the oversized crates in neutron counting equipment. The demonstration conclusively proved that air pallets facilitated more accurate positioning of the crates, reduced risk of crate damage during handling, and did so using equipment that is more easily decontaminated than the baseline technology. Two technologies were demonstrated that radiographed the contents of oversized crates to enhance the safety of crate opening and management. Both gamma interrogation and x-ray technologies were used to demonstrate identification of the equipment in oversized crates. A metal cutting technology was demonstrated for removal of glovebox legs and small appurtenances. Plans for further demonstrations in FY01 will also be presented.

INTRODUCTION

The Deactivation and Decommissioning Focus Area of the DOE National Energy Technology Laboratory established a Large Scale Demonstration and Deployment Project at Los Alamos National Laboratory to facilitate demonstration and deployment of technologies for the characterization, decontamination, and volume reduction of oversized metallic waste. The oversized metallic waste at LANL arises from the retrieval of approximately 2,400 m³ of oversized transuranic (TRU) metallic waste from storage. Most of this waste is in the form of TRU contaminated gloveboxes. The plan is to decontaminate and segregate these objects into TRU and low-level waste categories. The segregated or concentrated TRU waste from the retrieval and processing operations will be packaged and certified for shipment to the DOE's Waste

Isolation Pilot Plant (WIPP). The low-level waste portion will be volume-reduced and disposed of at LANL's solid waste disposal area. This contaminated glovebox disposal problem is common to many DOE sites. The Rocky Flats Environmental Technology Site is currently in closure and addressing approximately 8,000 m³ of TRU gloveboxes. Some crated TRU gloveboxes were sent to Idaho National Engineering and Environmental Laboratory from Rocky Flats and will be retrieved and processed for compliance with the WIPP requirements. Other DOE sites that have contaminated crated waste include Savannah River and Hanford.

Greg Becker at INEEL surveyed DOE sites for boxed waste and found boxes and crates ranging in size from 0.3 m³ to 36 m³ (Becker, 1999). The largest crates in the inventory are cargo containers. Most crates are in the range of 1 to 7 m³. The waste category of this boxed and crated waste is as follows;

TRU	8200 boxes
MLLW	12100 boxes
LLW	13800 boxes
Hazardous	400 boxes
Other	300 boxes

Rocky Flats recently published their experience on the cost of glovebox decontamination, dismantlement, decommissioning, and disposal (Kaiser Hill, 1999). If the Rocky Flats experience of \$30,000/m³ is applicable to the DOE wide problem, gloveboxes and their associated equipment represent a cost to DOE in excess of over \$400 million.

The LANL metallic waste currently in storage was generated through decontamination and decommissioning of plutonium-processing facilities during the late 1970s and early 1980s. This waste was packaged in fiberglass-reinforced plywood crates and consists primarily of gloveboxes (some with lead shielding), but the waste also includes piping, ducting, fume hoods, equipment and similar metallic items. Initial characterization information provided by the generators is limited but the primary radionuclide contaminant is believed to be TRU isotopes.

In FY-99 the Los Alamos LSDDP focussed demonstration activities to "front end" technologies, those associated with the initial characterization or disassembly of the gloveboxes after initial crate opening. This includes two technologies for imaging the contents of crates, one for facilitating transuranic survey of crates, and one for the removal of small appurtenances from the gloveboxes.

TECHNOLOGY DEMONSTRATIONS

Vehicle and Cargo Inspection System (VACIS™) for imaging large crates

The Vehicle and Cargo Inspection System (VACIS™) was developed by the Science Applications International Corporation (SAIC) for imaging of cargo containers and vehicles at US border crossings. The VACIS™ uses a 1.6 Curie collimated source (Cesium-137) aimed at a linear detector to create an image as the unit passes by the crate. In the mobile unit tested at LANL, the source and detector are mounted on a boom truck, with the source positioned in a shielded box at the end of the boom and the detector mounted on the truck. As the crate passes between the source and detector, a composite image of the contents is constructed from the linear image by the VACIS™ unit's on board computer.

The mobile VACIS unit was demonstrated in June 1999 at the LANL Solid Waste Operations Area, Technical Area 54, Area G. Waste containers consisting of fiber-glass reinforced plywood crates and

standard waste boxes (SWBs) were loaded onto flatbed trucks, driven to the demonstration area and imaged using the VACIS mobile unit. Once positioned, the driver exited the truck and the VACIS unit drove along the flatbed at approximately 20 cm/sec, compiling the image. Images were reviewed in near real-time and were recorded on disk. All phases of the operation were closely monitored by LANL radiation control technicians. Personnel from the US Army's Thunder Mountain Test and Evaluation Center operated the VACIS™, along with representatives from the unit's developer, SAIC.

During the two day test period, over 40 images of crates, boxes and miscellaneous truck cargos were obtained. The VACIS™ mobile unit provided quality images of the crate and waste container contents in which items such as glove boxes, debris inside glove boxes, equipment, tanks and filter media were clearly visible. Comparison of the image with the inventory description will greatly enhance inventory knowledge. Knowledge of the orientation of the objects within the FRP crate as well as equipment inside the glovebox will enhance crate disassembly and object re-sizing. Lead shielded objects appear dark on the VACIS™ image, allowing the user to ascertain the presence of lead. Knowledge of lead contents may be critical for mixed waste classification and scheduling of crate opening in the DVRS process.

The test results were reported in the Innovative Technology Summary Report and summarized below (DOE 2000 a).

- **Ease of technology implementation**

Implementation of the technology was straightforward. The VACIS™ unit itself requires only that the crates for imaging be elevated a minimum of 60 cm (2 ft) off the ground to allow for imaging of the entire vertical length. Flatbed trucks were used to elevate the crates. Imaging of the crates, once positioned on the flatbeds, was completed in less than 30 seconds.

- **Health and safety issues associated with technology deployment**

Based on radiation measurements conducted at the site of the demonstration, the VACIS™ unit poses negligible incremental exposure for workers and the surroundings.

- **Object resolution of the method, including ability to resolve superimposed objects as well as lead-shielded objects.**

The method shows excellent large object resolution, i.e. gloveboxes, equipment inside gloveboxes, filters, and hardware were clearly visible as such. Smaller object resolution was less successful. For example, known objects such as tools, a tire, a fire extinguisher and a 4 liter container of water that were placed in a relatively small (1 m by 1.3 m by 0.6 m deep) container yielded an indistinct image. Small container resolution could be improved by better configuring of the source and detector. Lead shielded objects were evident as definitive dark areas around the gloveports in the gloveboxes.

- **Cost-effectiveness and risk reduction offered by the technology**

The VACIS™ technology can be implemented at a per crate cost of about \$600, assuming one hundred crates are analyzed. A larger number of crates, or expedited crate handling procedures will reduce the per crate unit cost. The VACIS™ yielded crate images that were immediately useful with respect to inventory reconciliation and configuration of the contents. This data will enhance the worker safety opening and subsequent size reduction of crate contents. One of the demonstration objectives was identification of lead shielding. The VACIS™ images provide a clear identification of lead shielded gloveboxes which will not be opened until the process mixed waste processing procedures are well established. This cost avoidance also supports the cost effectiveness of VACIS™.

- **Decontamination ease and maintenance costs**

The VACIS™ unit did not require decontamination after the demonstration. The VACIS™ unit does not make direct contact with the crate to be imaged, rather a boom arm with the source is extended around the unit without making contact. There is the potential for contamination associated with the movement of the crates on and off the flatbed trailers if the crate integrity is not sound. LANL waste operations personnel are interested in future evaluation of VACIS™ for in-place imaging of these crates. Maintenance costs of the VACIS™ unit are minimal, with most of the maintenance of ownership entailing VACIS™ vehicle maintenance.

- **Identify the VACIS™ system configuration that best supports the LANL operations requirements.**

The imaging procedure used at the LANL demonstration involved loading the waste crates onto flatbed trucks and imaging the trucks and cargo using the VACIS™ system. This proved to be a good operational procedure for LANL. The VACIS™ unit's rate of imaging far exceeded the rate at which FRP crates could be loaded onto flatbed trucks and offloaded. The bottleneck for the imaging process was clearly the handling of the large FRP crates, including positioning for loading, loading onto flatbeds and subsequent offloading and replacement into storage. A future imaging operation might improve on these logistics and reduce per crate costs. SAIC personnel have stated that design options exist for improving the penetrating power of the source or improving the image resolution for DOE applications.

Two examples of an images from the VACIS™ unit are shown in Figures 1 and 2. In Figure 1, gloveboxes within two waste crate are clearly visible as is the equipment within the gloveboxes. Note also that lead shielding around the glove ports is visible in the second crate.



Figure 1
VACIS™ Image of Two Crates Containing Gloveboxes with Machine Tools and a Shielded Glovebox

Figure 2 shows a truck with two crates containing piping.



Figure 2
VACIS™ Image of Crates Containing Piping

Mobile Characterization Services NDE System real time radiography for large boxes

Mobile Characterization Services (MCS) operated VJ Technologies real time radiography (RTR) system for large boxes in a demonstration at the LANL Solid Waste Operations area in January 2000. This unit was developed to image crates to identify items that would violate the acceptance criteria of the Waste Isolation Pilot Plant. The x-ray technology is well established for radiography of drums, but this unit is the first of a kind to take large boxes. The VJ Technologies system provides a continuous video image of a small portion of the crate as the x-ray head traverses the crate, accepting crates up to approximately 2m high x 2m wide x 3m long. Depending on crate size and content, the imaging took 15 to 40 minutes per crate.

A total of 19 crates and standard waste boxes (SWB) were radiographed during the demonstration. The system proved its value in identification of crate contents and in particular its ability to identify small items such as electrical connectors and aerosol cans. It was also successful in identification of a vessel containing liquid. This capability alone will provide substantial benefit to the baseline process as it avoids a potential spill of liquid during the crate processing. The demonstration goals and the associated results are still under review and will be reported after analyses are complete.

Several crates imaged by the VJ Technologies unit were previously imaged by the VACIS. This comparison clearly showed the capabilities of the two units. The VACIS provides a rapid “gross” image of the crate contents and is very instructive for crates with identifiable gloveboxes and equipment. The VJ Technologies unit provides a detailed image of the container contents, and can identify small items from a heterogeneous pile of trash within the size limitations of the unit.

AeroGo Air Lift Pallets for precise positioning of large crates

The AeroGo air-caster system was demonstrated for moving the fiberglass-reinforced crates and standard waste boxes in June 1999. Packages weighing up to 2500 kg (5600 lbs) were moved and positioned precisely in a non-destructive assay system.

The AeroGo, Inc., air pallet system includes air casters, an air hose, and a pressure manifold distribution control box to “float” loads on a near frictionless film of air. The reduced friction and omni-directional movement allow the operator to precisely place and align the load in a limited workspace. Loads can be accurately positioned as needed for non-destructive assay analysis or for dismantlement.

After less than an hour of training by the AeroGo representative, the technicians were able to use the system to accurately position the large crates in the assay system and move them through the maze. Four LANL technicians were able to move a 2300 kg (5000 lb) crate through a 45 m (150 ft) long maze, rotate the crate 180°, and return the crate to the original position with minimal effort, completing the exercise in less than 3 minutes. The LANL radiation control specialists pointed out that the AeroGo system is advantageous as its geometry offers limited areas for contamination, and decontamination would be straightforward. The system works best on smooth finished floors but will operate over prepared cracks and slightly uneven surfaces.

The demonstration met the project objectives:

- **Provide easy and accurate placement of Crates in the Large Item Neutron Counter**
The AeroGo pallets facilitated easy and accurate placement of the crates in the counter with the ability to index a large crate to approximately 1 cm accuracy. Neither the baseline wheeled carts nor a forklift will provide the accuracy needed.

- **Improved Safety of operation**

The reduced requirement for fork lift application reduces the potential for contamination and breaching of the crates. In addition, the simple and design of the air pallets facilitates easy decontamination, if necessary.

- **Identify the recommended configuration for continued operation.**

Based on the demonstration results, LANL Solid Waste Operations ordered four air pallet systems; two of the design tested in the demonstration and two that facilitate movement of large crates with two technicians instead of four. The purchase of multiple units was possible as the units are relatively inexpensive. Crates will have to be positioned on blocks of the correct height to facilitate insertion of the air pallets.



Figure 3

LANL technicians position a 2500 Kg (5600 lb) crate in the Large Item Neutron Counter.

Mega-Tech Blade Cutting Plunger (BPC-4) for cutting legs and appurtenances from gloveboxes

The Mega-Tech Blade Plunging Cutter (BPC-4) and the Porter Cable's Tiger Saw model # 9737 were demonstrated for metal cutting of glovebox legs and appurtenances. The demonstration took place at The Florida International University Hemispheric Center for Environmental Technology (FIU-HCET) testing facilities to compare the innovative BPC-4 to the baseline technology, the reciprocating saw. Both 41 mm (1 5/8") Unistrut and 3" diameter steel pipe legs were removed from a glovebox mockup during the demonstration.

The BPC-4 is a portable hydraulic power cutting tool. It has a 10 cm (4") blade and is a piston-forced plunging cutter that operates through a recess in the anvil, severing the metal in a guillotine fashion during the 8 second stroke. The cutter weighs approximately 13 kg (28 lbs) and is 70 cm (28 inches) in length. It has a "dead man" switch for safe operations. It can be supported with a tension device when working from scaffolding, a lift, or a ladder. The HPU-12 Hydraulic Power Unit is mounted on a cart and powers the tool and can be located remotely from the cutter in a non-contaminated area.

The baseline technology was a Porter Cable variable speed Tiger Saw, a handheld general purpose-reciprocating saw with quick-change blade clamp. The saw weighs 4 kg (9 lbs), and is 43 cm (17") long.

The demonstration was conducted at the FIU-HCET facility simulating a radioactive environment typical of operation in the LANL Solid Waste Operations area. The cutting took place in a PermaCon with technicians in PPE and respirators. A mockup of a two station glovebox was constructed with options for two types of legs; Unistrut and three inch pipe. The mockup legs were positioned to be inconvenient, as common and expected in the LANL crated waste project. The tools were demonstrated by experienced waste management technicians from LANL.

The demonstration met the project objectives;

- **Provide a valid comparison of the speed of the Mega-Tech system and the baseline**
Data was taken on the severing of the legs for both the Unistrut and pipe legs. The results are shown in Table I.

Table I. Comparison of Average Cutting Times

Type of Leg	Average time to cut a leg (seconds)	
	BPC-4	Tiger Saw
Unistrut	18.4	29.3
Pipe	70.4	116.6

- **Provide a valid comparison of the secondary waste generation**
The Mega-Tech system produced essentially no cutting chips as shown in Table II.

Table II. Comparison of Metal Shavings Produced

Type of Leg	Metal Shavings (grams/cm cut)	
	BPC-4	Tiger Saw
Unistrut	0.0	0.141
Pipe	0.059	0.662

- **Provide a qualitative comparison of the ease of use of the Mega-Tech system and the baseline**
Technician consensus was that the innovative technology was easy to learn and use, but was awkward for use in inconvenient positions. Using the weight balance attachment would make the cutter easier to use. Technician remarks on the baseline were mixed. Although the technology was lighter and easier to maneuver, the vibrations during operation made it uncomfortable to operate for extended periods.
- **Provide a Qualitative Assessment of the safety comparison of the Mega-Tech system and the baseline**
The Mega-Tech system has a slow operating speed and the blade is recessed, so injury from cuts is reduced. The Mega-Tech system is more complex and therefore more challenging to protect from contamination. However, the reduced secondary waste from the Mega-Tech system reduces the potential for contamination.



Figure 4

LANL Technicians use the Mega-Tech BPC-4 to cut a 3 inch pipe leg from the glovebox mockup.

LANL LSDDP Future Activities

The Los Alamos LSDDP has focussed on “front end” technologies in FY-99 as that is the need of the baseline project. The baseline project is expected to be in operation in late FY00 with the remainder of the operations:

- Continued assay of packaged waste
- Manual opening of the plywood/fiberglass reinforced boxes
- Manual removal and disposal of packaging materials and equipment packed in the gloveboxes
- Manual size reduction
- Manual shielding removal
- Manual gross decontamination as required prior to entry into the baseline process chambers
- Decontamination for removal of plutonium holdup and minimization of TRU waste disposal volumes
- High-capacity mechanical volume reduction for waste minimization
- Final packaging and manifesting of end product waste materials for disposal at WIPP or at LANL.

Since the baseline process will not be fully functional in FY2000, the LSDDP activities will be limited to continued technology search and evaluation until FY2001. The intent is to have numerous technologies identified and preselected for demonstration in early FY2001.

REFERENCES

Kaiser Hill, L.L.C. “Facility Disposition Cost Model, Revision 2”, Rocky Flats Operations Office, May 1999.

Becker, G., McIlwain, M., and Connolly, M., “Transuranic and Low-Level Boxed Waste From Nondestructive Assay Technology Overview and Assessment”, Idaho National Engineering and Environmental Laboratory, INEEL/EXT-99-00121, February 1999.

U.S. Department of Energy, “Innovative Technology Summary Report; Waste Crate and Container Imaging Using the Vehicle and Cargo Inspection System (Draft)”, January 2000.

US Department of Energy, “Innovative Technology Summary Report; Mega-Tech Blade Cutting Plunger, BPC-4, (Draft),” February 2000.